PATENT SPECIFICATION

Application Date: June 13, 1938. No. 17463/38.

511,639

Complete Specification Accepted: Aug. 22, 1939.

COMPLETE SPECIFICATION

A Motor for the Conversion of Heat to Power

We, PERCY WARREN NOBLE, a Citizen of the United States of America, of Unadilla, County of Otsego, State of New York, United States of America, and HARRY NOBLE, a British Subject, of 73, The Close, Norwich, in the County of Norfolk, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a novel form of heat motor requiring only fuel without the provision of any other external source of supply or maintenance to perform work.

It consists broadly of a fluid pressure engine which may be either reciprocating, as for instance an ordinary piston-driven steam engine, or rotary, as exemplified by a turbine supplied with pressure vapour from a boiler or generator and exhausting into a condenser where the vapour is restored to the fluid condition, thereafter being returned by pumps to the boiler. The engine is enclosed within the casing of the boiler or condenser as may be most desirable, its torque being resisted by a pendulum attached to one element of the motor and the entire system is hermetically sealed after the air content has been reduced to the practicable minimum.

The boiler and condenser thus form a continuous sealed enclosure encompassing the motor unit with its attached pendulum. The movement of the pendulum, when displaced from its neutral position, provides the reactance for rotation, maximum torque being developed when the centre of gravity of the pendulum is at right angles to the neutral position. The enclosing casing rotates outside the motor unit and the pumps, attached to the rotating element, are actuated indirectly by the pendulum restraint. This combination of functions constitutes the minimum possible to complete the regenerative cycle of the working fluid and is practicable because the ability to completely free and seal the rotatable enclosure from internal air enables a very high efficiency to be achieved and maintained both for the boiler and the condenser. Since the boiler or generator rotates, its contained fluid is evenly distributed about its inner wall with pressure due to the centrifugal force, at a maximum at the surface of heat transfer and at a minimum at the surface of vapour release, thus avoiding insulation of the fluid from the heating surface by nascent vapour and permitting a high rate of heat transfer from heating surface to fluid. The vapour, having passed through the motor unit, is exhausted to the condenser, the effect of the latter also being augmented by the rotation. Vapour-free condensate is thus forced by centrifugal action to the induction orifices of the pumps.

The invention will be further described with reference to the accompanying drawings which illustrate one embodiment of the invention by way of example, but the invention is not restricted to the particular embodiment illustrated.

Figure 1 is a section through the whole assembly, Figures 2 and 3 shew the path of the flame and the device for governing its intensity, Figures 4 and 5 shew details of the pump unit and Figure 6 is a section through the motor unit.

Referring mainly to Figure 1, 2 is a vapour generator consisting of a ribbed cylinder of substantial strength which is free to rotate within a refractory enclosure 3, supported by a sheet metal structure 4 which in turn is carried by the main frame 5. The generator 2 is capable of being heated by a burner 6 which is supplied with fuel at 7 and governed for intensity as hereinafter described. The relation of the burner to the refractory enclosure 3 and the exit 8 for the burned gases may be seen clearly from Figures 2 and 3.

The condenser unit is shewn at 9 and the pump unit at 10. These units combine with the generator unit 2 to complete the sealed rotor carried in bearings 11 and 12 from the main frame 5 and circumscribing the motor unit 13 freely suspended within the rotor by the bearings 14 and 15. Its reactance bias is supplied by the mass 16—the pendulum

hereinbefore described.

The condenser unit 9, symmetrically disposed about the shaft 17, is mechanically jointed and permanently sealed by impermeable means to the pump unit 10, the stem of which provides support for the centre bearing 12 beyond which the generator unit 2 is overhung truly on the common axis. The crank shaft of the motor unit 13 provides for holding the generator and pump units coaxially in juxtaposition and for the transfer of vapour via the holes 18, the axial passage 19, the crank web lead 20 and the crank pin drilling 21 to the engine cylinders through the medium of the crank pin.

The joint 22 between the pump and generator units is compressed by screw 23 engaging the end of the crank shaft passage and made finally staunch by soldering, which process is extended to seal the screw head 23.

Grooves 24 provide for liquid transfer from the circumferential groove 25 formed in the hub of the pump unit to which groove the condensed fluid is delivered by the pumps shewn in greater detail in Figures 4 and 5.

Three cylinders of a uniflow design are employed in the interests of certain starting. Their heads form the crank pin bearings and vapour is admitted from the pin to the cylinders by the axial hole 27. Exhaust takes place by the circumferential openings 28 to the condenser space, a plate 29 perforated with many holes being provided to carry the outer support bearing 15 and to distribute the exhaust vapour evenly to the condenser vanes 30 (radial hair-pin-like strips soldered to the shaft 17), the shell 31 and the condenser head 32. The shell 31 may also be lined with a strip of perforated metal 31A to increase the surface area and therefore the cooling effect. Similarly soldered externally to the shell 31 is the corrugated band 33 also of perforated metal. Its function is to add cooling surface and provide fan action for the rapid circulation of air admitted to distribution through the holes 34, 35 pierced in the main frame end structure. Air exit is provided by the openings 36.

Figures 4 and 5 shew the pump unit. The eccentric 37 is formed in the hub of the motor unit case 13. The pump plunger 38 is reciprocated by the scotch-yoke elements 39 within the pump barrels 40 to which fluid is admitted at the holes 41 closed as the plunger 38 passes them. The pump barrels are contained in wells 42 of small cubic capacity, and the induction holes 41 are fed from these wells. Delivery is by the check valves 43 via the radial holes 44 to the groove 25 and thence by passages 24 to the interior of the generator.

Adjacent to the centre bearing and mounted on the bearing retention nut 45 is a non-ferrous disc 46. This disc (see Figures 2 and 3) travels between the poles of a magnet 47 attached to the shaft 48, supported by bearings 49 located in the casting 50 which carries in a slidable manner the burner tube 6 engaged with the lever 50A radial to the shaft 48. Eddy currents generated in the disc 46 by its motion through the magnetic field derived from the magnet 47 cause a drag which tends to rotate the magnet about the axis of the shaft 48. This drag is resisted by the governor spring 51 which is adjustably anchored at 52. The burner tube 6 being engaged with the governor lever 50A is therefore caused to move axially as the drag, proportioned to the speed of the disc, overcomes or is overcome by the strength of the spring 51. The gas supply tube 53 is terminated in a slot 54 which, when the governor spring is fully released, matches a slot in the burner tube. These slots are narrow, although ample to supply the volume of fuel; consequently a relatively small movement on the part of the burner tube under the influence of the governor lever is sufficient to control the effective gas supply and to govern the speed of the machine.

Further reference to Figures 1, 4 and 5 will show first a check valve 55 covered with a screw-down cap 56 in the condenser unit 9 and a taper plug 57 adjacent to one wall of the generator unit. These are used in the air-evacuation processes and are finally closed and sealed with solder.

There are many ways of evacuating the rotor, but a satisfactory method, by which the working medium is introduced at the same time, is to fill the rotor completely with liquid in order to eliminate all air and then by vaporisation to reduce the liquid content to a quantity which is insufficient to touch the rim of the motor unit when the machine is running. The motor unit is thus free from influence of the liquid contents of the surrounding hermetically sealed enclosure.

The degree to which air can be removed, and excluded thereafter, is of paramount importance to the final efficiency because the rate and capacity of the condenser depends upon it. Even slight traces of air are detrimental and one great advantage of the general design lies in the ability to secure and maintain this air-free condition without the addition of the auxiliary apparatus common to fluid

pressure power systems using a condenser. The system described comprises only the basic functional elements and no additions are needed. Even the problem of lubrication is eliminated because most liquids in the presence of their own vapour and without admixture of air are found to be efficient lubricants. It is recognised, however, that absolute air extraction is a practical impossibility since there is an exudation from the metal surfaces themselves that continues to release occluded gases absorbed during manufacture and rolling processes and while a " get " (an air-absorbing medium) can be embodied, as in vacuum tubes with metal enclosure, it is sufficient to accept the condition achieved by " boiling off " as practical.

Since the rotor is hermetically sealed, the working liquid may be chosen with regard to the temperatures between which it is desired to work. Thus alcohol, petrol, ether, water, carbon tetrachloride or any homogeneous liquid may be chosen as the working medium. Waste heat from other sources of power may be used instead of the burner above described and may thus be usefully converted into work. Thus a pipe supplying hot waste gases may be substituted for the burner 6. Auxiliary apparatus may be driven from the exhaust of internal combustion engines, as for example supercharging apparatus may be driven from the exhaust of aircraft engines.

The efficiency of motors such as that above described cannot exceed that of the vapour pressure engines using the same cycle, although the internal losses are definitely less. The absence of piping and of auxiliary apparatus, the augmentation in efficiency of the boiler and condenser arrangements under air-free conditions and centrifugal action and the reduction of the internal friction to a minimum all combine to secure a high figure of efficiency. The structure and conditions are, however, favourable to high pressures and superheat if desired, and speed characteristics may be chosen to almost an unlimited range; in this respect motors of the said type are superior to electric motors which must be related to fixed supply conditions.

Safety is ensured by the complete enclosure of the high speed elements.

Increase in size is favourable to the design because the moment of the pendulum is greatly increased with the increased diameter.

In the above description, air cooling of the condenser is used; water cooling may be used, if desired, with no added complication.

The machines are susceptible of being perfectly balanced dynamically and may therefore be free from vibration and silence is inherent.

The machine above described operates on town gas but it will be obvious that by modifying the fuel-burning provisions any source of heat supply may be adopted.

The machines cannot be made to exceed full load torque developed when the pendulum is displaced through ninety degrees except by a momentary acceleration of the pendulum mass. The capability of the machine is in general measured by the capacity of the condenser since the type of vapour generator may be forced to very high rates of evaporation. The mean effective pressure involved is a function of the pendulum movement, full load torque being similarly so after allowance has been made for internal friction and pump drive losses.

The starting is not instantaneous, but is delayed for a period dependent upon the mass of the generator, its contained liquid, the thermal value and volume of fuel concentration and external resistance.

Where economy of fuel is an important consideration, the cylinder cut-off or the turbine nozzle change may be made dependent upon the displacement of the pendulum from its neutral position.

In general it is desirable to isolate the generator unit thermally as much as possible from the condenser unit, for example by overhang of the generator unit in the manner described, but it need not necessarily be accomplished so. The specific mechanical arrangement will vary widely with the requirements and characteristics desired.

The particular design described is for a fractional horse-power machine suitable for interchange with an electric motor of similar output.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A motor for the conversion of heat into power consisting of a substantially air-free rotor comprising a vapour generator and a condenser, a vapour pressure driven prime mover between the generator and condenser whose torque is resisted by a pendulum, the said prime mover being entirely enclosed within the confines of the rotor, a pump by which condensate is returned to the generator, a supply of vaporisable liquid insufficient to contact the pendulum or the parts it controls when distributed about the walls of the rotor, a source of heat for the generator, a source of lower temperature

for the condenser and a bearing support for the rotor.

2. A motor for the conversion of heat into power comprising a vapour pressure generator and a source of heat therefor, a condenser coaxial with and hermetically sealed to the vapour pressure generator, both being free from internal air but containing vaporisable liquid and the vapour thereof, a pressure-sensitive prime mover rotatably suspended about the axis of the generator and condenser biased as to one of its elements by a pendulum and so arranged that pressure difference between the generator and condenser causes flow through the prime mover and the performance of work, and a pump returning condensate from the condenser to the generator.

3. In a motor for the conversion of heat to power, an hermetically sealed rotatable enclosure comprising a vapour pressure generator capable of being heated, an engine sensitive to the vapour pressure one element of which is restrained from rotation by a pendulum and the other element of which is attached to the rotatable enclosure, a condenser capable of being cooled to receive the exhaust from the engine and connected with and sealed to the generator, a supply of vaporisable liquid and a pump for forcing condensed liquid from the condenser to the generator, the enclosure being substantially free from all gases other than the vapour of the specific vaporisable liquid.

4. A motor for the conversion of heat into power comprising a pendulum-restrained vapour-driven prime mover free from influence of the liquid contents of a surrounding hermetically sealed enclosure part of which is a condenser for the exhaust of the prime mover and a further hermetically sealed enclosure which is a vapour pressure generator capable of being heated, the said hermetically sealed enclosures communicating only by the functional elements of the prime mover and by a passage for the return of liquid from the condenser to the generator, both enclosures being substantially free from air.

5. A motor for the conversion of heat into work having a sealed rotor from which all air has been extracted, one of the parts being a vapour pressure generator capable of being heated and containing a vaporisable liquid and its vapour, another part being a condenser capable of being cooled and containing vapour and vaporisable liquid, and a vapour pressure-sensitive, pendulum-restrained engine coaxial with the rotor, transfer of vapour from the generator to the condenser being solely by means of passage through the engine and the transfer of liquid from the condenser to the generator being solely by means of a rotating barrel pump actuated by a pendulum-restrained eccentric.

6. A motor for the conversion of heat into power comprising an engine driven by vapour pressure, the power shaft of which is coaxial with and attached to a completely sealed enclosure circumscribing the engine, the reactance element of the engine being attached to and restrained from rotation by a pendulum, the said sealed enclosure being divided by the engine into a vapour pressure generator where heat is applied to a vaporisable liquid contained therein and a condenser wherein the vapour, having performed work in the engine-forming division, is reduced to a liquid form and returned to the generator by a rotating barrel pump driven by a pendulum-restrained eccentric, the liquid in both the generator and condenser being distributed evenly upon the circumferential walls by centrifugal force and the pump being fed with liquid under centrifugally imposed pressure.

7. A motor for the conversion of heat into power constructed, arranged and adapted to operate substantially as herein described and shewn in the accompanying drawings.

Dated this 13th day of June, 1938.

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47, Lincoln's Inn Fields,
London, W.C.2,
Agents.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1939.

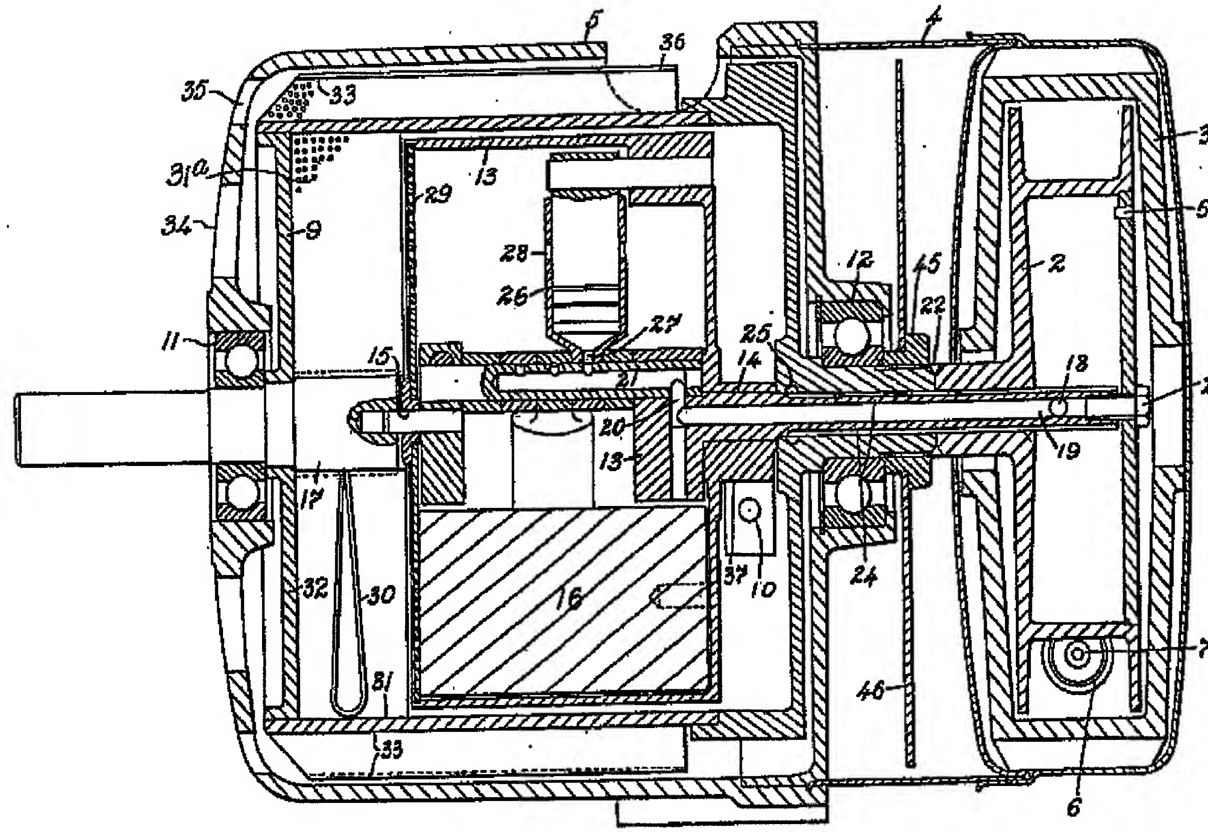

Fig. 1.

[This Drawing is a full-size reproduction of the Original.]

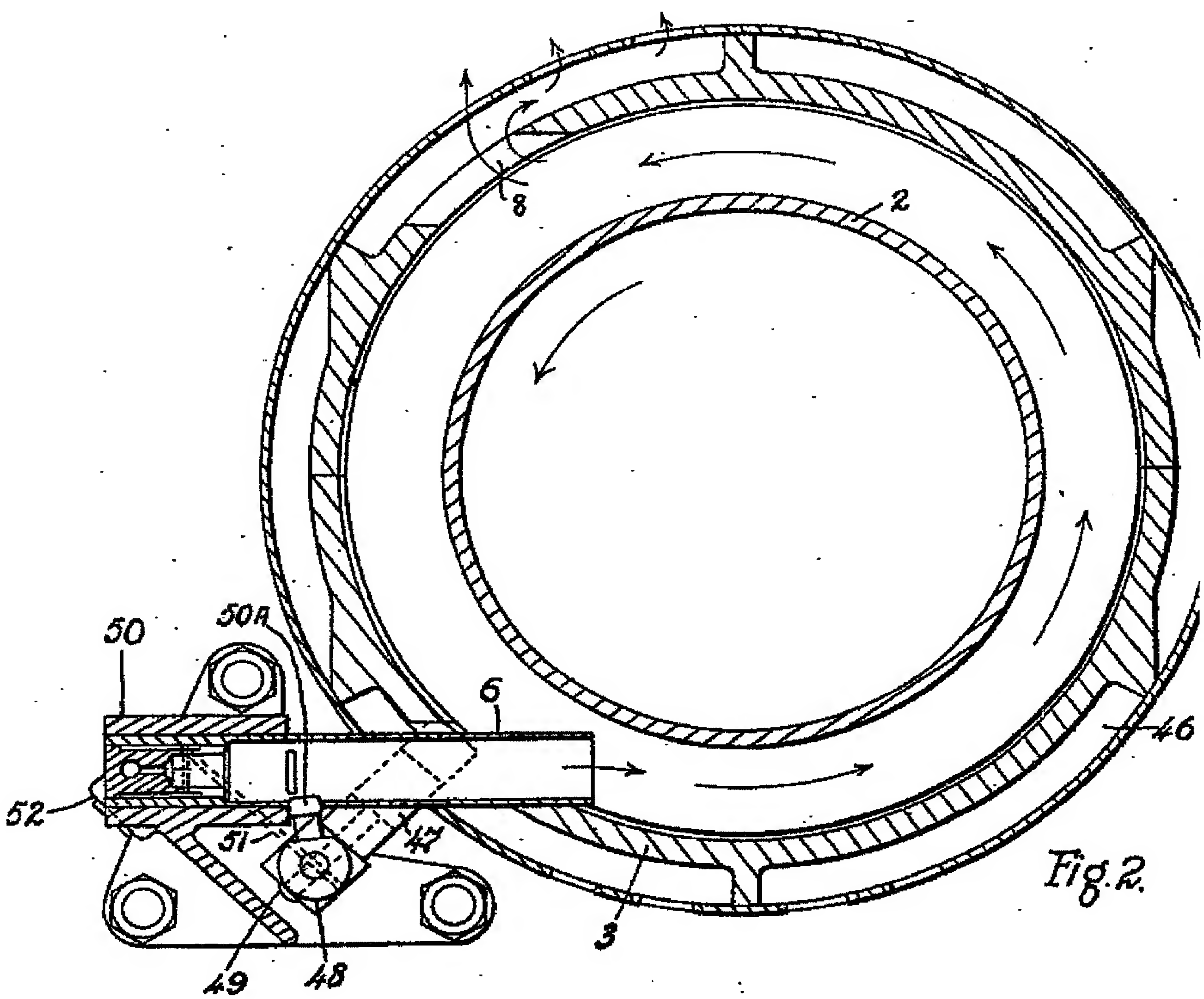

Fig. 2.

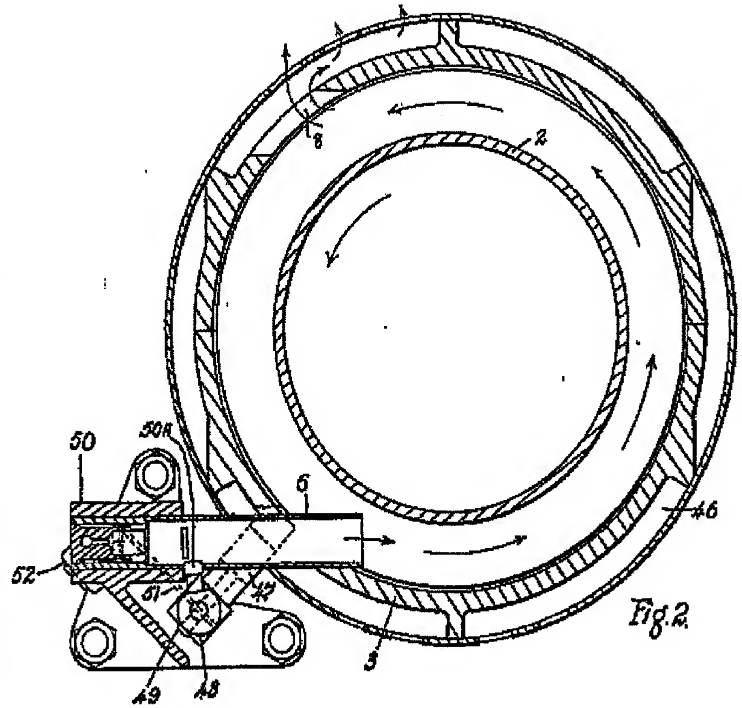

Fig. 2.

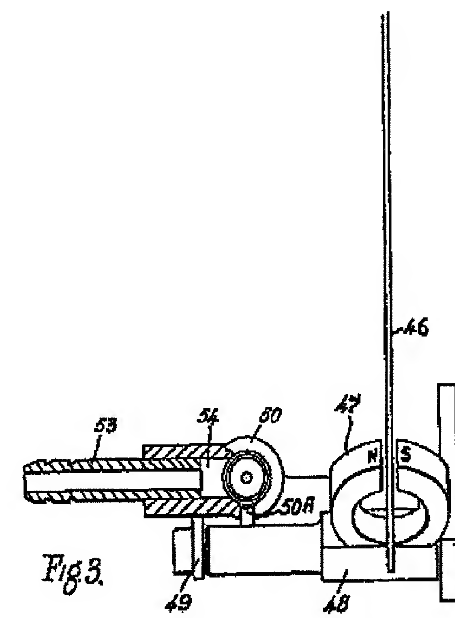

Fig. 3.

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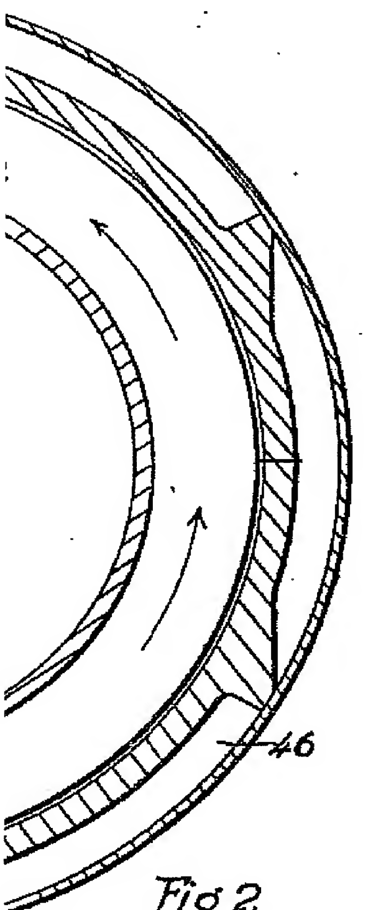


Fig.2.

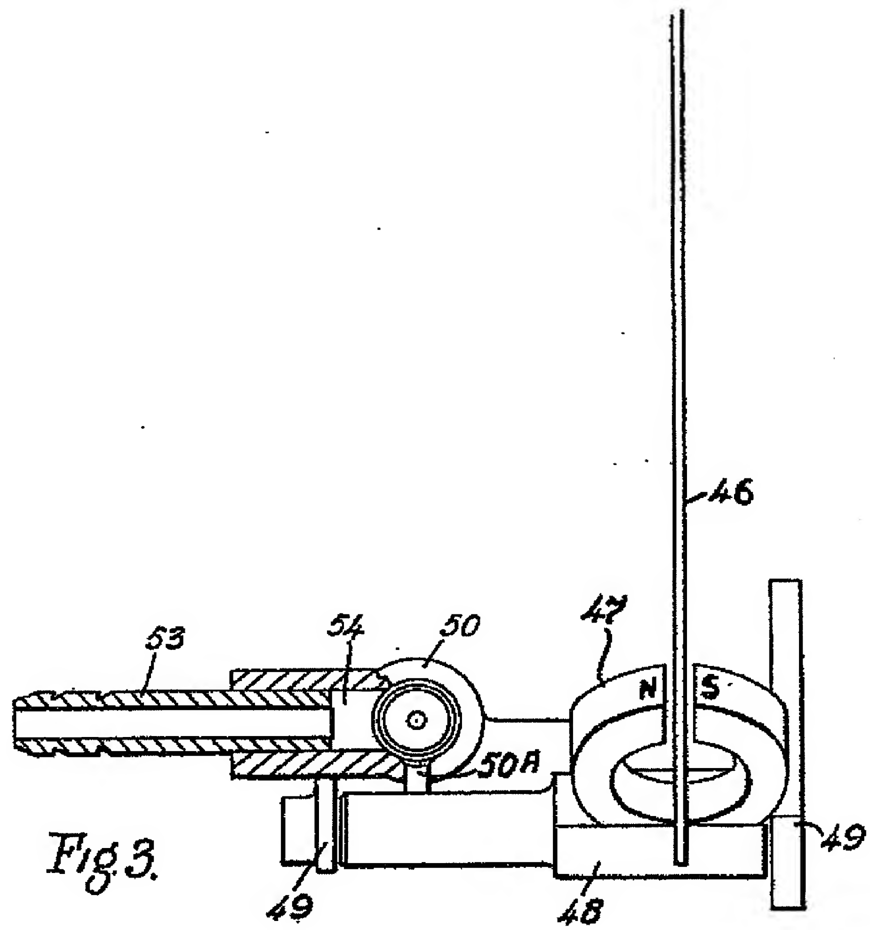


Fig.3.

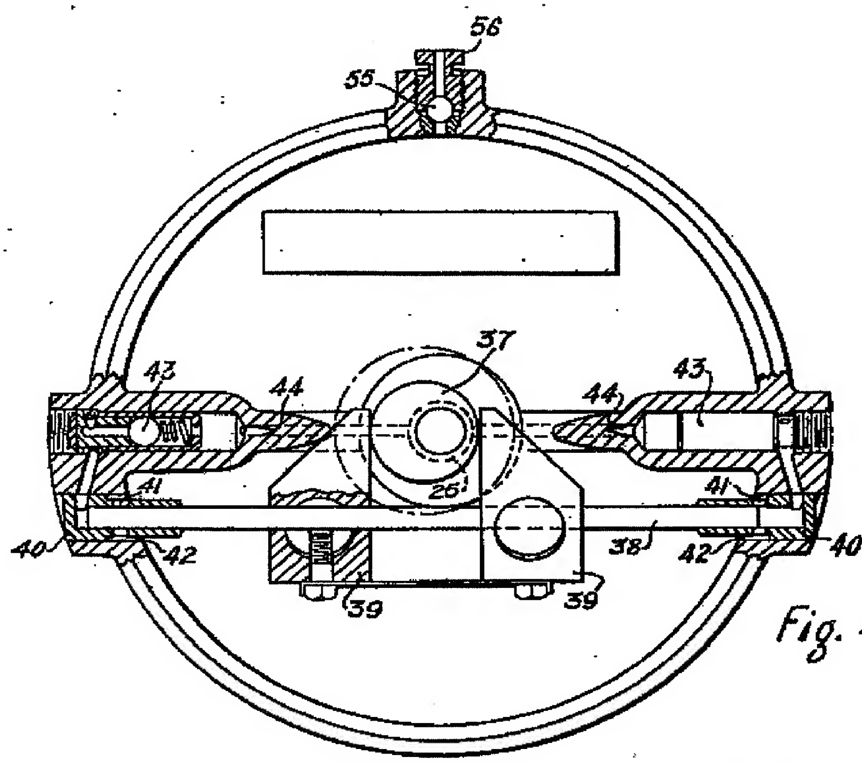


Fig. 4.

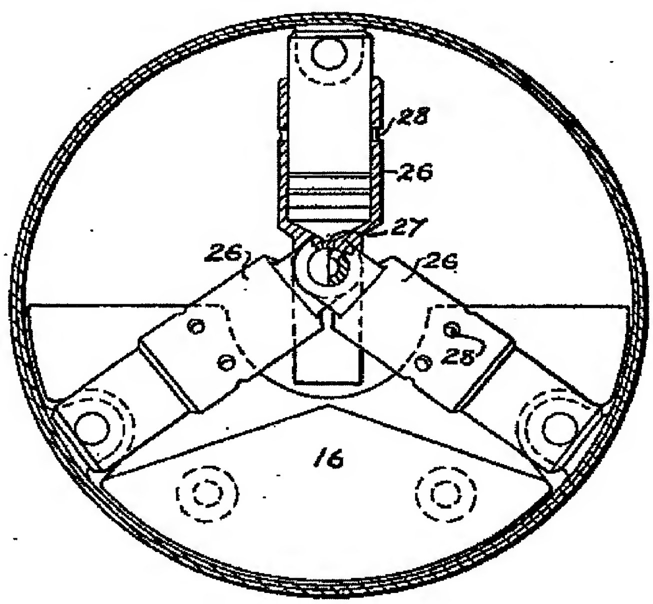


Fig. 6.

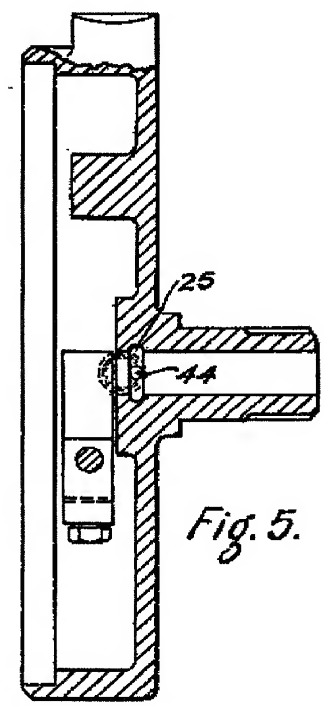
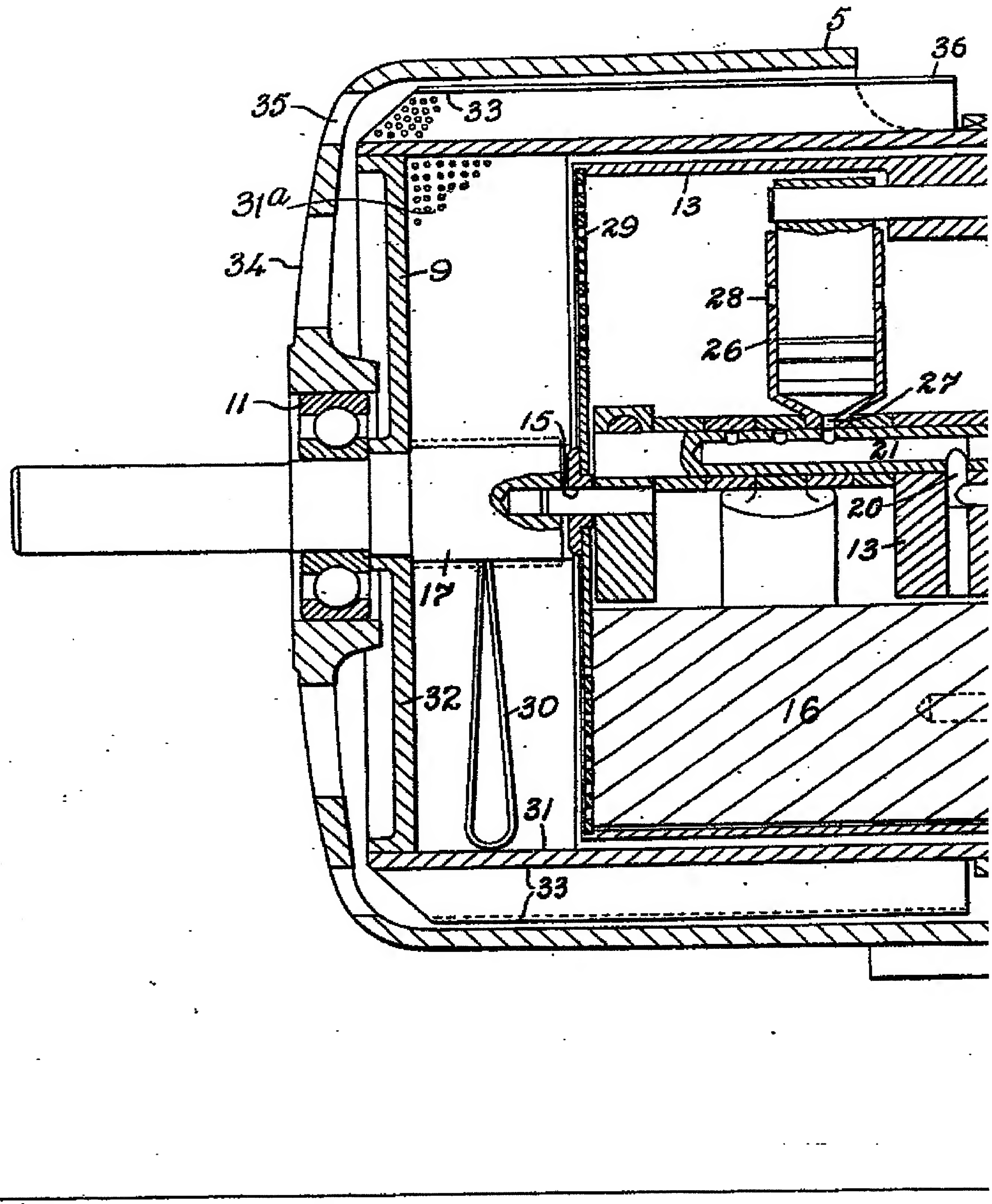


Fig. 5.

[This Drawing is a full-size reproduction of the Original.]



3 SHEETS
SHEET 1

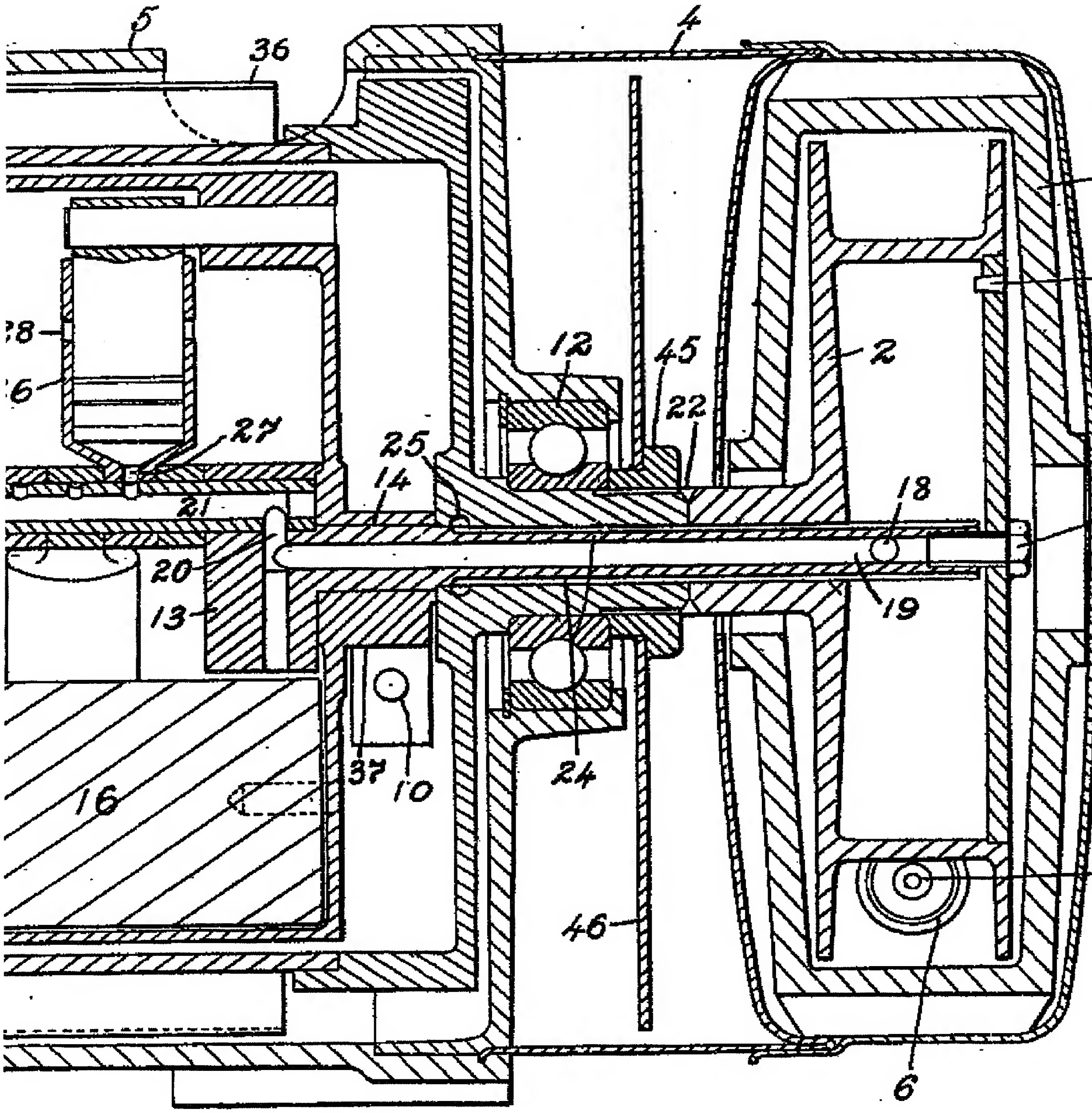


Fig. 1.

Malby & Sons, Photo-Litho.